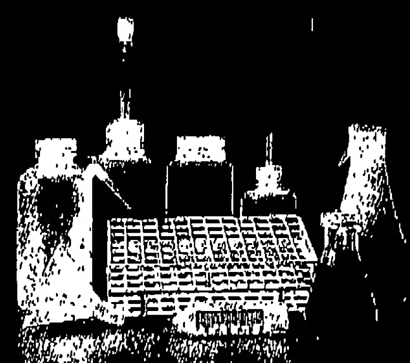
NALGENE

Labware 2000



www.nalgenunc.com

Catalogue 2

Replacement Closures for NALGENE Bottles and Carboys

Refer to the Bottle Chart in this catalog to determine which closure fits your specific bottle.

Bottle Neck Size	Description	Replacement Part No.	Pkg. Qty.
13 mm	Screw Closure, PP	71-2150-0130	12
13 mm	Amber Screw Closure, Amber PP	71-2171-0130	12
13 mm	Screw Closure, Natural Tefzel ETFE*	71-2174-0130	2
20 mm	Screw Closure, PP	71-2150-0200	12
20 mm	Screw Closure, HDPE	71-2151-0200	12
20 mm	Screw Closure, Amber PP	71-2171-0200	12
20 mm	Screw Closure, Teflon PFA*	71-2172-0020	2
20 mm	Screw Closure, Natural Tefzel ETFE*	71-2174-0200	2
24 mm	Screw Closure, PP	71-2150-0240	12
24 mm	Screw Closure, HDPE	71-2151-0240	12
24 mm	Screw Closure, Amber PP	71-2171-0240	12
24 mm	Screw Closure, Natural Tefzel ETFE*	71-2174-0240	2
28 mm	Screw Closure, PP	71-2150-0280	12
28 mm	Screw Closure, HDPE	71-2151-0280	12
28 mm	Screw Closure, Amber PP	71-2171-0280	12
28 mm	Screw Closure, Black Tefzel ETFE*	71-2173-0280	2
28 mm	Screw Closure, Natural Tefzel ETFE*	71-2174-0280	2
33 mm	Screw Closure, PP	71-2150-0330	12
33 mm	Screw Closure, Natural Tefzel ETFE*	71-2174-0330	2
38 mm	Screw Closure, PP	71-2150-0380	12
38 mm	Screw Closure, HDPE	71-2151-0380	12
38 mm	Screw Closure, Amber PP	71-2171-0380	12
38 mm	Screw Closure, Black Tefzel ETFE*	71-2173-0380	2
38 mm	Screw Closure, Natural Tefzel ETFE*	71-2174-0380	2
38-430	Screw Closure, HDPE	71-2151-0384	12
38-430	Screw Closure, PP	71-2160-0384	12
38-430	Screw Closure, Amber PP	71-2171-0384	12
38-430	Screw Closure, Teflon PFA*	71-2172-0384	2
38-430	Screw Closure, Natural Tefzel ETFE*	71-2174-0384	2
43 mm	Screw Closure, PP	71-2150-0430	12
43 mm	Screw Closure, Amber PP	71-2171-0430	12
43 mm	Screw Closure, Natural Tefzel ETFE*	71-2174-0430	2
48 mm	Screw Closure, PP	71-2150-0480	12
48 mm	Screw Closure, Amber PP	71-2171-0480	12
48 mm	Screw Closure, Natural Tefzel ETFE*	71-2174-0480	2
53B	Screw Closure, HDPE	71-2151-0053	12
53B	Screw Closure, PP	71-2160-0530	12
53B	Screw Closure, Amber PP	71-2171-0530	12
53 mm	Screw Closure, PP	71-2150-0530	12
53 mm	Screw Closure, Natural Tefzel ETFE*	71-2174-0530	2
63 mm	Screw Closure, PP	71-2150-0630	12
63B	Screw Closure, Amber PP	71-2171-0630	12
70 mm	Screw Closure, HDPE	71-2151-0070	2
70 mm	Mason Jar Closure, White PP	71-2154-0700	12
83B	Screw Closure, HDPE	71-2151-0083	2
83B	Screw Closure, PP	71-2160-0830	2
100 mm	Screw Closure, PP	71-2150-1000	12
120 mm	Large Jar Closure, White PP	71-2155-1200	12

*or equivalent. Teflon and Tefzel are registered trademarks of DuPont.

Resins - Reference

POLYOLEFINS

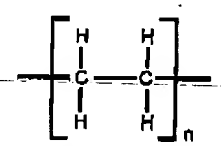
Polyolefins are high-molecular-weight hydrocarbons. They include: low-density, linear low-density and high-density polyethylene; polypropylene copolymer; polypropylene, and polymethylpentene. All are nontoxic and non-contaminating and exhibit varying degrees of break resistance. These are the only plastics lighter than water. They easily withstand exposure to nearly all chemicals at room temperature for up to 24 hours. Strong oxidizing agents eventually cause embrittlement. All polyolefins can be damaged by long exposure to ultraviolet light.

Polyethylene The polymerization of ethylene results in an essentially straight-chain, high-molecular-weight hydrocarbon. The polyethylenes are classified according to the relative degree of branching (side chain formation) in their molecular structures, which can be controlled with selective catalysts.

Like other polyolefins, the polyethylenes are chemically inert. Strong oxidizing agents will eventually cause oxidation and embrittlement. They have no known solvent at room temperature. Aggressive solvents will cause softening or swelling, but these effects are normally reversible.

Low-density polyethylene (LDPE) has more extensive branching, resulting in a less compact molecular structure.

High-density polyethylene (HDPE) has minimal branching, which makes it more rigid and less permeable than LDPE.

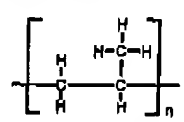


HIGH-DENSITY POLYETHYLENE

Linear low-density polyethylene (LLDPE) combines the toughness of low-density polyethylene with the rigidity of high-density polyethylene.

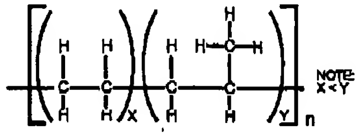
Cross-linked high-density polyethylene (XLPE) is a form of high-density polyethylene wherein the individual molecular chains are bonded to each other (using heat, plus chemicals or radiation) to form a three-dimensional polymer of extremely high molecular weight. This structure provides superior stress-crack resistance and somewhat improves the toughness, stiffness and chemical resistance of HDPE. XLPE is a superior material for molding very large storage tanks.

Polypropylene (PP) is similar to polyethylene, but each unit of the chain has a methyl group attached. It is translucent, autoclavable and has no known solvent at room temperature. It is slightly more susceptible than polyethylene to strong oxidizing agents. It offers the best stress-crack resistance of the polyolefins. Products made of polypropylene are brittle at 0°C and may crack or break if dropped from benchtop height.



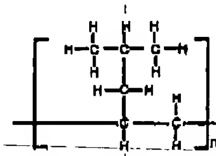
POLYPROPYLENE

Polypropylene copolymer (PPCO) replaces polyallomer (PA) and is an essentially linear copolymer with repeated sequences of ethylene and propylene. It combines some of the advantages of both polymers. PPCO is autoclavable and offers much of the high-temperature performance of polypropylene. It also provides some of the low-temperature strength and flexibility of polyethylene.



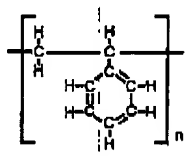
POLYPROPYLENE COPOLYMER

Polymethylpentene (PMP or TPX†) is similar to polypropylene, but it has an isobutyl group instead of a methyl group attached to each monomer group of the chain. Its chemical resistance is close to that of PP. It is more easily softened by unsaturated and aromatic hydrocarbons, and chlorinated solvents. PMP is slightly more susceptible than PP to attack by oxidizing agents. Its excellent transparency, rigidity and resistance to chemicals and high temperatures make PMP a superior material for labware. PMP withstands repeated autoclaving, even at 150°C. It can withstand intermittent exposure to temperatures as high as 175°C. Products made of polymethylpentene are brittle at ambient temperature and may crack or break if dropped from benchtop height.



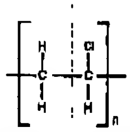
POLYMETHYLPENTENE

Polystyrene (PS) is rigid and non-toxic, with excellent dimensional stability and good chemical resistance to aqueous solutions, but limited resistance to solvents. This glass-clear material is commonly used for disposable laboratory products. Products made of polystyrene are brittle at ambient temperature and may crack or break if dropped from benchtop height.



POLYSTYRENE

Polyvinyl Chloride (PVC) is similar in structure to polyethylene, but each unit contains a chlorine atom. The chlorine atom renders it vulnerable to some solvents, but also makes it more resistant in many applications. PVC has extremely good resistance to oils (except essential oils) and very low permeability to most gases. Polyvinyl chloride is transparent and has a slight bluish tint. Narrow-mouth bottles made of this material are relatively thin-walled and can be flexed slightly. When blended with phthalate ester plasticizers, PVC becomes soft and pliable and can be extruded into flexible tubing.



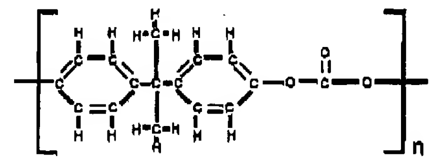
POLYVINYL CHLORIDE

Thermoplastic elastomer (TPE) is a type of polyolefin which, due to structure, molecular weight and chemistry, can be molded into autoclavable parts which are rubber-like in application and performance. It is used for several small caps and plugs on filtration and ultracentrifuge ware products.

ENGINEERING RESINS

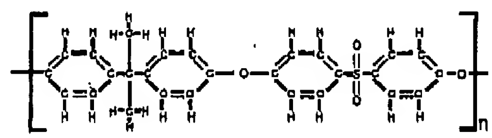
These resins offer exceptional strength and durability in demanding lab applications. For specific uses, they are superior to the polyolefins. Typical products are centrifuge ware, filterware and safety shields.

Polycarbonate (PC) is window-clear, amazingly strong and rigid. It is autoclavable, nontoxic and the toughest of all thermoplastics. PC is a special type of polyester in which dihydric phenols are joined through carbonate linkages. These linkages are subject to chemical reaction with bases and concentrated acids and hydrolytic attack at elevated temperatures (e.g., during autoclaving). This makes PC soluble in various organic solvents. For many applications, the transparency and unusual strength of PC offset these limitations. Its strength and dimensional stability make it ideal for high-speed centrifuge ware. Spectrophotometric analysis shows that the polycarbonate used in NALGENE safety products is essentially opaque to ultraviolet light from 200 to 380 nanometers (nm): 0% transmittance from 200-300 nm, 0.2% transmittance up to 380 nm. This covers the wavelengths emitted for germicidal applications such as laminar flow hoods (254 nm) and for fluorescence detection of dyes in electrophoresis or chromatography developing (350-360 nm).



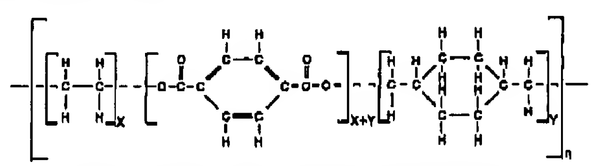
POLYCARBONATE

Polysulfone (PSF) Like polycarbonate, PSF is clear, strong, non-toxic and extremely tough. PSF is less subject than PC to hydrolytic attack during autoclaving and has a natural straw-colored cast. PSF is resistant to acids, bases, aqueous solutions, aliphatic hydrocarbons and alcohols. PSF is composed of phenylene units linked by three different chemical groups – isopropylidene, ether and sulfone. Each of the three linkages imparts specific properties to the polymer, such as chemical resistance, temperature resistance and impact strength.



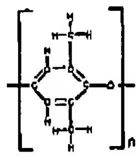
POLYSULFONE

Polyethylene Terephthalate G Copolyester (PETG) is similar to many other engineering resins. However, its glass-like clarity, toughness and excellent gas-barrier properties make it an outstanding choice for storing biologicals. Tests have shown PETG to be biologically equivalent to, or better than, Type I borosilicate glass bottles for cell culture applications. In tests using a wide variety of cell lines, PETG was determined to be non-cytotoxic, and media stored in PETG bottles demonstrated proliferative and morphological characteristics comparable to control media. In fact, the PETG bottles allowed growth of good monolayers directly on the surface of the bottle. PETG can be sterilized with radiation or compatible chemicals but cannot be autoclaved. Its chemical resistance is fair.



POLYETHYLENE TEREPHTHALATE G COPOLYESTER

Polyphenylene Oxides (PPO) A patented process for oxidative coupling of phenolic monomers is used to forumlate Noryl' phenylene oxide-based thermoplastic resins. This family of engineering materials is characterized by outstanding dimensional stability at elevated temperatures, broad temperature-use range, outstanding hydrolytic stability and excellent dielectric properties over a wide range of frequencies and temperatures. Among their design advantages are: (1) excellent mechanical properties over temperatures from below -40°C (-40°F) to above 48°C (300°F); (2) self-extinguishing, non-dripping characteristics; (3) excellent dimensional stability and low water absorption; (4) resistance to aqueous chemical environments, and (5) excellent impact strength.



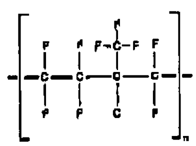
PHENYLENE OXIDE

FLUOROCARBONS

Typical fluorocarbons are Teflon tetrafluoroethylene (TFE)* and Teflon fluorinated ethylene propylene (FEP)*. Both have remarkable chemical resistance.

Teflon TFE* is opaque white and has the lowest coefficient of friction of any solid. It makes superior stopcock and separatory funnel plugs.

Teflon FEP* is translucent, flexible and feels heavy because of its high density. It resists all known chemicals except molten alkali metals, elemental fluorine and fluorine precursors at elevated temperatures. It should not be used with concentrated perchloric acid. FEP withstands temperatures from -270°C to +205°C and may be sterilized repeatedly by all known chemical and thermal methods. It can even be boiled in nitric acid.

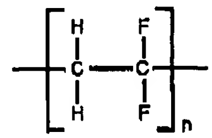


TEFLON FEP

Tefzel ETFE* is translucent white and slightly flexible. It is a close analog of Teflon* fluorocarbons, an ethylene tetrafluoroethylene copolymer. ETFE shares the remarkable chemical and temperature resistance of Teflon TFE* and FEP* and has even greater mechanical strength and impact resistance.

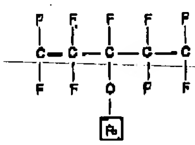
Halar ECTFE** is an alternating copolymer of ethylene and chlorotrifluoroethylene. This fluoropolymer withstands continuous exposure to extreme temperatures and maintains excellent mechanical properties across this entire range (from cryogenic temperatures to 180°C). It has excellent electrical properties and chemical resistance and has no known solvent at 121°C. It is also non-burning and radiation-resistant. Its ease of processing makes it suitable for a wide range of products.

Polyvinylidene Fluoride (PVDF, best known as Kynar*)** is a fluoropolymer with alternating CH2 and CF2 groups. PVDF is an opaque white resin. Extremely pure, it is superior for non-contaminating applications. Mechanical strength and abrasion resistance are high, similar to ECTFE. It resists UV radiation. The maximum service temperature for rotationally-molded PVDF tanks is 100°C. Up to this temperature, PVDF has excellent chemical resistance to weak bases and salts, strong acids, liquid halogens, strong oxidizing agents and aromatic, halogenated and aliphatic solvents. However, organic bases and short-chain ketones, esters and oxygenated solvents will severely attack PVDF at room temperature. Fuming nitric acid and concentrated sulfuric acid will cause softening. At temperatures approaching the service limit, strong caustic solutions will cause partial dissolution. Autoclavable if tanks are empty and externally supported.



POLYVINYLIDENE FLUORIDE

Teflon PFA* is translucent and slightly flexible. It has the widest temperature range of the fluoropolymers – from -270°C to +250°C – with superior chemical resistance across the entire range. Compared to TFE at 277°C, it has better strength, stiffness and creep resistance. PFA also has a low coefficient of friction and outstanding antistick properties and is flame-resistant.



TEFLON PFA

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+Registered trademark of Mitsui & Co., Ltd.
*or equivalent. Teflon and Tefzel are registered trademarks of DuPont.
**or equivalent. Halar is a registered trademark of Ausimont USA, Inc.
***Registered trademark of Elf Atochem

Reference/Use & Care Guide

The following material includes general guidelines on the use and care of plastic laboratory products. For more information, contact your NALGENE Labware Dealer or Nalge Nunc International.

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International Department
Nalge Nunc International
Rochester, NY USA
Tel: 1-716-264-3898
Fax: 1-716-264-3706
intlmktg@nalgenunc.com

General Cleaning

NNI recommends using non-alkaline detergents for cleaning plastic labware, especially those products made of polycarbonate, which is particularly sensitive to alkaline attack.

NALGENE L-900 Liquid Detergent (Cat. No. 900) is designed to clean all plastics at a neutral pH. A 5% solution in water is usually sufficient but can be increased to 20% for stubborn residue or heavily-soiled labware. L-900 Detergent can be used in automatic washers for lightly- to normally-soiled items.

Soak the labware in the detergent for up to 3 hours, then gently wash with a cloth or sponge. Soak heavily-soiled items in a 5 to 20% concentration in water for 4 or more hours prior to washing. Rinse with tap water and then distilled water.

- Do not use abrasive cleaners or scouring pads on any plastic labware.
- Periodically disassemble and clean spigots and threads on bottles and closures to prevent salt build-up, which can cause leakage.
- Most plastics, particularly the polyolefins (LDPE, HDPE, PP, PMP and PPCO) have non-wetting surfaces that resist attack and are easy to clean.

Dishwashers

Labware washing machines can be used with all resins except LLDPE, acrylic and PS, due to temperature limitations.

Sp cial note on polycarbonate (PC)

Repeated washings in the dishwasher weaken the exceptional strength of PC. PC labware that has been exposed to high stresses (such as those caused by centrifugation or use in vacuum chambers) should always be washed by hand using a mild, neutral pH, non-abrasive detergent without sheeting agents, such as NALGENE L-900.

Keep the dishwasher cycle time to a minimum. Use the plastics cycle and set the water temperature at 135°F (57°C) or lower. Remove the labware as soon as possible after cooling is complete. Avoid excessive abrasion of plastics by covering metal spindles with soft material such as plastic tubing. Plastic labware should be weighted down and held in place with accessory racks.

Ultr sonic Cleaners

Ultrasonic cleaning units may be used to clean labware as long as the labware does not rest directly on the transducer diaphragm.

Special Problems

Greases and Oils

For many applications, washing with a mild detergent will remove greases and oils. When more rigorous cleaning is needed, organic solvents may be used with caution. Extended exposure to these solvents may cause some swelling of polyolefins. Rinse off all solvents before using labware. Use only alcohols on PC, PSF, PS and PVC; other organic solvents will attack these plastics. Do not use organic solvents with acrylic.

Organic Matter

Chromic acid solution will remove organic matter, but will eventually embrittle plastics. To minimize embrittlement, soak plastic for no more than 4 hours. The following formula is the recommended cleaning agent:

Dissolve 120 grams of sodium dichromate (Na_2, Cr_2O_7-$2H_2O$) in 1000 ml tap water. Carefully add 1600 ml concentrated sulfuric acid. Note: Because this solution generates considerable heat, we recommend external cooling. Do not mix in a plastic container.

This solution is designed to produce an excess of dichromate in the form of a precipitate which actually extends the useful life of chromic acid and dissolves as needed. This chromic acid solution can be used repeatedly until it begins to develop a greenish color, indicating a loss of potency. As a result of the excess dichromate built into this formula, the solution lasts much longer than commercially-available solutions.

Sodium hypochlorite solutions (bleach) are also effective in removing organic matter. Use at room temperature.

Centrifuge Ware

After centrifugation, loosen pellets by presoaking the tube or bottle overnight in a mild detergent solution (we recommend NALGENE L-900). Do not soak PC centrifuge ware in alkaline detergents. If the pellet contains microbiological or hazardous material, refer to Hazardous Matter section. After soaking, use a pipet or soft rubber policeman to further loosen the pellet. A soft bristle brush may be used if care is taken not to scratch the plastic.

Trace Level Cleaning

Summary of Average Element Content of 12 Plastics and Borosilicate Glass[1]

Material	No. of Elements	Total Conc., ppm	Major Constituents
PS	8 (8 N.D.*)	4	Na, Ti, Al
PSF	16 (12 N.D.)	17	Na, Fe, Ca
TFE	24	19	Ca, Pb/Fe, Cu
LDPE	18	23	Ca, Cl, K
PC	10	85	Cl, Br, Al
PMP	14	178	Ca, Mg, Zn
FEP	25	241	K, Ca, Mg
PVC-tubing	9	280	Fe, Zn, Sb
PP	21	519	Cl, Mg, Ca
HDPE	22	654	Ca, Zn, Si
ETFE	32	1,007	Cl, Pb, Si
PVC-rigid	7 (11 N.D.)	2,541	Sn, Ca, Mg
Borosilicate Glass	14	497,249	Si, B, Na

*N.D. = Not Detected

NOTE: Values listed in the chart above represent typical contents for major constituents. Various grades of plastics may vary from these values.

[1]Selection and Cleaning of Plastic Containers for Storage of Trace Element Samples, John R. Moody and Richard Lindstrom, ANALYTICAL CHEMISTRY, Vol. 49, Page 2264, December 1977.

As the chart "Summary of Average Element Content of 12 Plastics and Borosilicate Glass" shows, for most trace metal analysis, plastic is generally "cleaner" or less contaminated than glass or other materials. However, plastic does contain trace levels of certain metals. To minimize potential low-level contamination, remove these metals or leach them from plastic by soaking in 1N HCl and rinsing in distilled water. For extremely precise work, use HCl, followed by soaking in 1N HNO3 and rinsing in distilled water. Soaking time may vary according to individual needs, but plastic should be soaked no longer than 8 hours. If more rigorous cleaning is desired, increase the concentration of acids used. **Caution:** concentrated nitric acid is a strong oxidizing agent and will embrittle many plastics.

Interpretation of Chemical Resistance

The Chemical Resistance Chart and Chemical Resistance Summary Chart that follow are general guidelines only. Because so many factors can affect the chemical resistance of a given product, you should test under your own conditions. If any doubt exists about specific applications of NALGENE products, please contact Technical Service, Nalge Nunc International, Box 20365, Rochester, New York 14602-0365, or call (800) 625-4327, Fax (800) 625-4363. International customers, contact our International Department at +1 (716) 264-3898, Fax +1 (716) 264-3706. In Europe, contact Nalge (U.K.) at +44 (0) 1432 26393, Fax +44 (0) 1432 351923.

Additional Chemical Resistance Information

This chemical resistance chart is to be used for all labware including containers up to 50L. For NALGENE centrifugeware or UltraPlus centrifuge ware please refer to those charts in this catalog.

For chemical resistance of PETG (polyethylene terephthalate copolyester), see below.

For NALGENE fluorinated containers, including fluorinated high-density polyethylene (FLPE) and fluorinated polypropylene (FLPP), see inside back cover.

Effects of Chemicals on Plastics

Chemicals can affect the strength, flexibility, surface appearance, color, dimensions or weight of plastics. The basic modes of interaction which cause these changes are: (1) chemical attack on the polymer chain, with resultant reduction in physical properties, including oxidation; reaction of functional groups in or on the chain, and depolymerization; (2) physical change, including absorption of sol-vents, resulting in softening and swelling of the plastic; permeation of solvent through the plastic,and dissolution in a solvent, and (3) stress-cracking from the interaction of a "stress-cracking agent" with molded-in or external stresses. Also see "Chemical Resistance Classification".

The reactive combination of compounds of two or more classes may cause a synergistic or undesirable chemical effect. Other factors affecting chemical resistance include temperature, pressure and internal or external stresses (e.g., centrifugation), length of exposure and concentration of the chemical. As temperature increases, resistance to attack decreases.

Mixing and/or dilution of certain chemicals in NALGENE labware can be potentially dangerous. There active combination of different chemicals or compounds of two or more classes may cause an undesirable chemical effect or result in an increased temperature which can affect chemical resistance (as temperature increases, resistance to attack decreases). Other factors affecting chemical resistance include pressure and internal or external stresses (e.g., centrifugation), length of exposure and concentration of the chemical.

Environmental Stress-Cracking

Environmental stress-cracking is the failure of a plastic material in the presence of certain types of chemicals. This failure is not a result of chemical attack. Simultaneous presence of three factors causes stress-cracking: tensile strength, a stress-cracking agent and inherent susceptibility of the plastic to stress-cracking.

Common stress-cracking agents are detergents, surface active chemicals, lubricants, oils, ultra-pure water and plating additives such as brighteners and wetting agents. Relatively small concentrations of stress-cracking agent may be sufficient to cause cracking.

Mixing and/or dilution of certain chemicals may result in reactions that produce heat and can cause product failure. Pre-test your specific usage and always follow correct lab safety procedures.

ATTENTION: Please be aware that, although several polymers may have excellent resistance to various flammable organic chemicals and solvents, OSHA H CFR 29 1910.106 for flammable and combustible materials, or other local regulations, may restrict the volumes of solvents which may legally be stored in an enclosed area.

Caution

Do not store strong oxidizing agents in plastic labware except that made of FEP or PFA. Prolonged exposure causes embrittlement and failure. While prolonged storage may not be intended at time of filling, a forgotten container will fail in time and result in leakage of contents. Do not place any plastic labware in a flame.

First letter of each pair applies to conditions at 20°C; the second to those at 50°C. At 20°C->EG<-at 50°C.

Resin Codes:

ECTFE	Halar ECTFE* (ethylene-chlorotrifluoroethylene copolymer)
ETFE	Tefzel ETFE† (ethylene-tetrafluoroethylene)
FEP	Teflon FEP† (fluorinated ethylene propylene)
HDPE	high-density polyethylene
LDPE	low-density polyethylene
PC	polycarbonate
PETG	polyethylene terephthalate copolymer
PFA	Teflon PFA† (polyfluoroalkoxy)
PMP	polymethylpentene
PP	polypropylene
PPCO††	polypropylene copolymer
PS	polystyrene
PSF	polysulfone
PVC	polyvinyl chloride
PVDF	polyvinylidene fluoride
TFE	Teflon TFE† (tetrafluoroethylene)
TMX	Thermanox
PMX	Permanox

*Halar is a registered trademark of Ausimont USA, Inc.

†Or equivalent. Teflon and Tefzel are registered trademarks of DuPont.

††PPCO has replaced polyallomer (PA) in all products.

CHEMICAL	LDPE	HDPE	PP	PPCO	PMP	PETG	FEP	TFE	PFA	ECTFE	ETFE	PC	RIGID PVC	FLEX. PVC	PSF	PS	PVDF	TMX	PMX
1,4-Dioxane	GF	GG	FN	GF	GF	–	EE	EE	EE	EF	EF	NN	NN	FN	GN	NN	NN	EF	FN
2,2,4-Trimethylpentane	FN	FN	FN	FN	FN	–	EE	EE	EE	EG	EG	NN	NN	NN	GF	NN	EE	–	FN
2-Methoxyethanol	EG	EE	GE	EE	EE	FN	EE	EE	EE	EG	EG	NN	FN	FN	NN	NN	EE	G-	EE
2-Propanol	EE	EE	EE	EE	EE	–	EE	EE	EE	EE	EE	EE	EF	GN	GF	EG	EE	EN	EE
Acetaldehyde	GN	GF	GN	GN	GN	–	EE	EE	EE	GF	EF	NN	NN	NN	NN	NN	NN	–	GN
Acetamide, Sat.	EE	EE	EE	EE	EE	–	EE	EE	EE	EE	EE	NN	NN	NN	NN	EE	GN	EG	EE
Acetic Acid, 05%	EE	EE	EE	EE	EE	FN	EE	EE	EE	EE	EE	EG	EF	EG	EE	EG	EE	EG	EE
Acetic Acid, 50%	GF	EG	EE	EE	EE	NN	EE	EE	EE	EG	EE	GF	EN	FN	EE	GG	EE	EG	EE
Acetic Acid, Glacial	GN	GG	EG	EG	GG	NN	EE	EE	EE	EE	EE	NN	EN	NN	EE	FN	EG	EG	EG
Acetic Anhydride	NN	FF	GF	GF	EG	–	EE	EE	EE	EE	EE	NN	NN	NN	NN	NN	NN	–	EG
Acetone	NN	NN	GN	GG	EE	NN	EE	EE	EE	EG	GN	NN	NN	NN	NN	NN	NN	FN	EE
Acetonitrile	EE	EE	EG	FN	FN	–	EE	EE	EE	EE	EE	NN	NN	NN	NN	NN	GG	–	FN

E - No damage after 30 days of constant exposure.
G - Little or no damage after 30 days of constant exposure.
F - Some effect after 7 days of constant exposure.
N - Immediate damage may occur. Not recommended for continuous use.

Reference • Physical Properties of NALGENE® Labware

	Max. Use Temp. (°C)[1]	HDT[1] Temp. (°C)	Brittleness Temp. (°C)[13]	Transparency	Microwavability[2]	Autoclaving	Sterilization[4] Gas	Dry Heat	Radiation	Disinfectants	Specific Gravity	Flexibility	Permeability (cc-mil/100in²-24 hr. atm) N_2	O_2	CO_2	Water Absorption (%)	Non Cytotoxicity[6]	Suitability for Food and Bev. Use[7] Rating	Reg. Part 21 CFR
ETFE	150	104	-105	Translucent	Yes	Yes	Yes	Yes	Yes	Yes	1.7	rigid	30	100	250	0.03	Yes	Yes	–
ECTFE	150	119	-105	Translucent	Yes	Yes	Yes	Yes	No	Yes	1.69	rigid	18	25	110	0.01	Yes	Yes	–
FEP	205	158	-270	Translucent	Marginal[3]	Yes	Yes	Yes	No	Yes	2.15	excel	320	750	2200	<0.01	Yes	Yes	177.1550
FLPE	120	65	-100	Translucent	No	No	Yes	No	Yes	Yes	0.95	rigid	42	185	580	<0.01	–	Yes[8]	177.1520
HDPE	120	65	-100	Translucent	No	No	Yes	No	Yes	Yes	0.95	rigid	42	185	580	<0.01	Yes	Yes[9]	177.1520
LDPE	80	45	-100	Translucent	Yes	No	Yes	No	Yes	Yes	0.92	excel	180	500	2700	<0.01	Yes	Yes[9]	177.1520
PC	135	138	-135	Clear	Marginal[3]	Yes[5]	Yes	No	Yes	Some	1.2	rigid	50	300	1075	0.35	Yes	Yes	177.1580
PEI	170	210	–	Clear Amber	Yes	Yes	Yes	–	Yes	Yes	1.27	rigid	19	37	171	0.25	–	Yes	177.1595
PET	150	75	-40	Transparent	–	No	Yes	No	Yes	Some	1.2	mod	0.7-1.0	3-9	15-25	0.25	–	–	–
PETG	70	70	-40	Clear	Yes	No	Yes	No	Yes	Yes	1.27	mod	10	25	80	0.15	Yes	Yes[10]	177.1315
PFA	260	166	-270	Translucent	Yes	Yes	Yes	Yes	No	Yes	2.15	excel	291	881	2260	<0.03	Yes	No	–
PK	220	218	-40	Opaque	Yes	Yes	Yes	–	Yes	Some	1.24	rigid	–	0.2	1.6	0.45	–	–	–
PMMA	50	93	20	Clear	No	No	No	No	Yes	Some	1.2	rigid	–	–	20	0.35	Yes	–	–
PMP	175	85	20	Clear	Yes	Yes	Yes	Yes	No	Yes	0.83	rigid	1100	4500	–	0.01	Yes	Yes[11]	177.1520
PP	135	107	0	Translucent	Yes	Yes	Yes	No	No	Yes	0.9	rigid	48	240	800	<0.02	Yes	Yes	177.1520
PPCO	121	90	-40	Translucent	Marginal[3]	Yes	Yes	No	No	Yes	0.9	mod	45	200	650	<0.02	Yes	Yes	177.1520
PPO	100	149	-170	Opaque	–	Yes	–	No	Yes	No	1.06	rigid	–	1000	–	0.06	–	Yes	177.2460
PS	90	105	20	Clear	No	No	Yes	No	Yes	Some	1.05	rigid	55	300	1150	0.05	Yes	Yes	177.1640
PSF	165	174	-100	Clear Yellow	Yes	Yes	Yes	Yes	Yes	Some	1.24	rigid	55	300	700	0.3	Yes	Yes	177.1655
PUR	82	<25	-70	Clear	No	No	Yes	No	Yes	Yes	1.2	excel	41-119	75-827	450-1650	0.03	Yes	–	–
PVC (rigid)	70	90	-30	Clear	Yes	No	Yes	No	No	Some	1.34	rigid	2-20	4	4	0.15-0.75	Yes	Yes[9]	–
PVC (tubing)	82	-32	-32	Clear	Yes[14]	Yes	Yes	No	No	Some	1.34	excel	–	100-1400	20-12,000	0.15-0.75	Yes	Yes[9]	–
PVDF	150	139	-62	Translucent	–	Yes	Yes	No	No	Yes	1.75	rigid	9	14	505	0.05	Yes	Yes	177.2510
SAN	93	104	20	Clear	–	No	Yes	No	–	No	1.08	rigid	–	–	–	0.2	–	–	–
Silicone	200	-46	-117	Translucent	–	Yes	Yes	–	Yes	Yes	1.16	excel	43000	123000	312000	0.1	Yes	Yes	177.2600
TPE	121	<23	<-50	Opaque	Yes	Yes	Yes	No	–	Some	0.9	excel	31-145	85-646	800-8634	0.1-0.42	Yes	–	–
TFE	288	200	-100	Opaque	Yes	Yes	Yes	Yes	No	Yes	2.20	rigid	–	–	–	<0.01	Yes	–	–
XLPE	65	59	-118	Translucent	No	No	Yes	No	Yes	Yes	0.93	rigid	–	–	–	<0.01	Yes	–	–
Permanox®	180	85	-10	Transparent	Yes	Yes	Yes	Yes	No	Yes	0.84	rigid	–	–	–	<0.01	–	–	–
Thermanox®	150	75	-60	Transparent	–	No	Yes	No	Yes	Some	1.30	mod	0.7-1.0	3-6	15-25	0.25	–	–	–

[1] Heat Deflection Temperature is the temperature at which a bar deflects 0.01 in. at 66 psig (ASTM D648). Materials may be used above Heat Deflection Temperatures in non-stress applications; see Max. Use Temp.

[2] Ratings based on 5-minute tests using 600 watts of power on exposed, empty labware. CAUTION: Do not exceed Max. Use Temp., or expose labware to chemicals which heating causes to attack the plastic or be rapidly absorbed.

[3] Plastic will absorb heat.

[4] STERILIZATION:
- Autoclaving (121°C, 15 psig for 20 minutes) — Clean and rinse items with distilled water before autoclaving. (Always completely disengage threads before autoclaving.) Certain chemicals which have no appreciable effect on resins at room temperature may cause deterioration at autoclaving temperatures unless removed with distilled water beforehand.
- Gas — Ethylene Oxide, formaldehyde, hydrogen peroxide
- Dry Heat (160°C, 120 minutes)
- Disinfectants — Benzalkonium chloride, formalin/formaldehyde, ethanol, etc.
- Radiation — gamma irradiation at 25 kGy (2.5 MRad) with unstabilized plastic.

[5] Sterilizing reduces mechanical strength. Do not use PC vessels for vacuum applications if they have been autoclaved. Refer to Use and Care Guidelines for NALGENE Labware, for detailed information on sterilizing.

[6] "Yes" indicates the resin has been determined to be non-cytotoxic, based on USP and ASTM biocompatibility testing standards utilizing an MEM elution technique on a WI38 human diploid lung cell line.

[7] Resins meet requirements of CFR21 section of Food Additives Amendment of the Federal Food and Drug Act. End users are responsible for validation of compliance for specific containers used in conjunction with their particular packaging applications.

[8] Acceptable for aqueous foods only, at temperatures up to 121°C/250°F. Not sanctioned for use with alcoholic or fatty foods at any temperature.

[9] Acceptable for:
- Nonacid, aqueous products; may contain salt, sugar or both (pH above 5.0)
- Dairy products and modifications; oil-in-water emulsions, high or low fat
- Moist bakery products with surface containing no free fat or oil
- Dry solids with the surfaces containing no free fat or oil (no end-test required) and under all conditions as described in Table 2 of FDA Regulation 177.1520 except condition A – high temperature sterilization (e.g. over 100°C/212°F)

[10] Acceptable for:
- Alcoholic foods containing not more than 15% (by volume) alcohol; fill and storage temperature not to exceed 49°C (120°F)
- Non-alcoholic foods of hot fill not to exceed 82°C (180°F) and 49° C (120°F) in storage.
- Not suitable for carbonated beverages or beer or packaging food requiring thermal processing.

[11] Straight-sided jars, beakers and graduated cylinders only.

[12] Acceptable for aqueous, oil, dairy, acidic, and alcoholic foods up to 71°C/160°F.

[13] The brittleness temperature is the temperature at which an item made from the resin may break or cracked if dropped. This is not the lowest use temperature if care is exercised in use and handling.

[14] The tubing will become opaque from absorbed water.

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